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Dr. Parsons's Report to the Local Government Board on an outbreak of Scarlet Fever, with associated Diphtheria and Sore Throat, occurring in the Macclesfield Rural and Urban Sanitary districts in connexion with a particular supply of Milk.

George Buchanan,
Medical Department,
May 13th, 1889.

Circumstances under which inquiry was made.

On February 7th 1889, the Local Government Board received from the Macclesfield Rural Sanitary Authority a communication informing them of a severe outbreak of disease which had occurred within the previous ten days in the township of Upton in their district. The disease was described as "resembling scarlet fever (especially in children)," but "accompanied by "diphtheritic sore throat and symptoms of blood poisoning." It was stated that the milk supply in all cases had been obtained from the same farm, and that a number of cases of similar character had also occurred in the borough of Macclesfield among people who had obtained their milk from the same source. No sickness among the cattle at the farm or in the farmer's family had been found. The letter concluded with a request for the assistance of one of the Board's Inspectors to investigate the outbreak, and was accompanied by a memorial from some of the inhabitants of Upton to the same effect.

In compliance with this request I was directed to undertake the duty. On my arrival at Macclesfield on February 11th, I met the officers of the Rural Sanitary Authority, and learning from them that, concurrently with the outbreak in Upton, there had been a large number of cases of scarlet fever in Macclesfield, I requested and obtained from the Board instructions to extend my inquiry to the borough as far as was necessary for an understanding of the outbreak.

Description of locality.

The township of Upton is a small one, containing, in 1881, 39 inhabited houses with 185 inhabitants. It now contains 41 houses and 228 inhabitants. Most of the houses are on the side next Macclesfield, forming practically a suburb continuous with the borough; they are villas inhabited by private residents and people of the middle class who have business in the town. They are supplied with the town water, but do not drain into the town sewers, the sewage being carried into cesspools or water courses. There are also a few farm houses and cottages. The situation is elevated about 500 feet above the sea level, and the soil is sandy.

The part of Macclesfield immediately adjoining Upton is of similar character, but further in the town are streets of smaller houses inhabited by artizans. It is on the side of Macclesfield towards Upton, the west side, that the scarlet fever has mostly occurred; more distant parts, comprising the older, lower, and poorer parts of the town having almost escaped.

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As the circumstances of the outbreak were the same on both sides of the artificial line which separates Upton from Macclesfield, it will be convenient to treat of it as a whole; and the account given of it will be understood to apply to both places unless one or the other is specially mentioned.

Sudden outbreak of scarlet fever,

The outbreak has been sudden in its onset. In the borough of Macclesfield the notification of cases of infectious disease is compulsory upon medical men under the Macclesfield Corporation Act, 1882. The following is the number of cases of scarlet fever reported to the Sanitary Authority under the provisions of that Act, since the commencement of the year 1889:—

Week ending.	Cases.
January 5	1
„ 12	1
„ 19	—
„ 26	—
February 2	32
„ 9	7
„ 16	4
„ 23	2

In Upton no cases of scarlet fever are known to have existed before January 24th, but between January 24th and February 1st, 10 cases of scarlet fever occurred, in seven different households. The Macclesfield Rural District, an extensive area, had, so far as known, been previously almost free from scarlet fever. Some cases occurred in the latter part of December in Prestbury, a village beyond Upton, and in the latter part of January and beginning of February, besides the outbreak in Upton, scattered cases were reported in seven different and widely separated townships, viz., Mottram St. Andrew, Bosley, Chelford, Rainow, Prestbury, Macclesfield Forest, and Langley.

The four former places are outlying villages, distant from Upton. The cases at Prestbury, Macclesfield Forest, and Langley, were inquired into by me. There was in most of them a history of probable exposure, at school or at home, to infection from previous cases, known or unrecognised. The only connexion traceable between any of these and Upton was that two children, living in an outlying cottage in Upton and using no milk, but going to Prestbury school, were taken ill of scarlet fever on January 24th and 30th respectively. These cases, however, were apparently unconnected with the main outbreak at Upton.

accompanied by cases of severe sore throat,

It was noticed that the cases of scarlet fever in Upton and Macclesfield were accompanied, often in the same household, by a more numerous series of cases of sore throat, occurring chiefly in older persons, varying in severity, the more serious having a diphtheritic tendency, and two developing into distinct diphtheria. The cases which were termed scarlet fever appear to have presented certain peculiar clinical features, to which I shall have to refer later on.

among customers of a particular dairyman,

It was further remarked, by January 31st, that all or almost all the patients in Upton and Macclesfield had procured their milk from a Mr. V., a farmer and milk seller of Upton, and on that day two medical men took the responsibility of calling on Mr. V. and, although they could find nothing on his premises to account for the outbreak, of advising him to discontinue the sale of his milk. With this advice Mr. V., much to his credit, complied. No milk was sent out after the morning delivery of January 31st, and after that day the number of fresh cases of scarlet fever and associated sore throat rapidly declined.

I shall have to show by figures that the inferred connexion of the outbreak with the distribution of Mr. V.'s milk was thoroughly justified, but before doing so I wish to disclaim imputing blame to Mr. V. for the misfortune which has happened to his customers and himself, and to add my testimony to the care and intelligence with which his business is managed; to his readiness to afford me all information; and to his desire to do his duty to his neighbours even at the cost of present loss to himself.

I was furnished by Mr. V. junior with lists of the customers of the dairy in the order in which they were visited, and with the daily quantity of milk taken at each household. In all 103 households took the milk, of which 41 were served in the morning only, 22 in the evening only, and the remainder both morning and evening. The round commenced at Upton and went on to Macclesfield, the order in which the houses were visited in the latter part of the round being somewhat different in the morning and the evening. I may here state that no difference was observed in the incidence of disease upon the consumers

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of the morning and of the evening milk, except that those who took milk both morning and evening took on the whole a larger quantity, and suffered more than those who took it only once a day.

Of the 103 houses where the milk was taken, information as to the number of inmates and the occurrence of sickness was obtained at 100; at the remaining three the parties had removed. The 100 houses contained 492 inmates, of whom 150 were under the age of 15 and 352 above that age; and there had occurred in them recently 38 cases of scarlet fever, two of well-marked diphtheria, and 83 of sore throat of greater or less severity. In 58 out of the 100 houses, cases of one or other of these forms of diseases had occurred, and 123, or 25 per cent., of the inmates had been attacked. The appended table, Appendix I., shows the particulars as regards the several households. The incidence respectively on persons under and above the age of 15 will be mentioned in a later paragraph.

The first 22 households are in Upton township. They are mostly houses of the better class at which a good deal of milk was drunk; 17 of them had been invaded by disease. The 22 houses contained 106 inmates (of whom 23 were under 15 and 83 above that age); of these 40, or 37·5 per cent., were attacked by disease in one or other form. For the sake of comparison all the other houses in Upton township (18, besides Mr. V.'s own) were visited. They contained 116 inhabitants (of whom 41 were under 15, and 75 above). Among these, cases of illness were found at three only, viz.:—

1. Two cases of scarlet fever, the first commencing January 24th, clearly traceable to attendance at the Prestbury village school, at which persons had been attending from infected houses.
2. Three cases of "mumps," the first about December, in the cottage adjoining 1.*
3. A slight case of sore throat about the latter part of January.

Counting all these, we get the following comparison:—

Households in Upton.

Milk obtained from	House-holds.	Inmates.	Cases of			Percentage attacked.	
			Searlet Fever.	Diph-theria.	Sore Throat.	House-holds.	Persons.
Mr. V. - - - -	22	106	8	1	34	77·	37·5
Other sources, or none - -	18	116	2	—	4	16·7	5·2

In Macclesfield a similar numerical comparison can only be made in respect of the cases returned as scarlet fever. In the week ending February 2nd 1889 there were notified 32 such cases, of which 28 were persons habitually using Mr. V.'s milk. Mr. V. supplies 78 households in Macclesfield, containing 386 persons. There are 60 registered milk dealers selling milk in the borough, so that as the borough contained in 1881 8,552 inhabited houses, and 37,514 inhabitants, each dealer would supply on an average 142 houses and 625 persons, or nearly twice as many as Mr. V. Probably, however, the proportion which Mr. V. furnishes of the total amount of milk used in Macclesfield is greater than the proportion of houses supplied by him, since many of his customers are of the well-to-do class, who use a good deal of milk.

Of the four cases of scarlet fever notified in the week ending February 2nd in persons not habitually drinking Mr. V.'s milk, one occurred in a house in which there had been a previous case some weeks before; it was in a low part of the town, and the back yard and privy were used jointly with a common lodging house. Another child had probably occasionally drunk Mr. V.'s milk. The other two cases occurred in one house, with an interval of three days between them; the source was not discovered.

Of the seven cases notified as scarlet fever in the week ending February 9th, three were in persons who had been using Mr. V.'s milk. The others occurred in different parts of the town (two in one family), and some of them in association with cases of measles.

Two or three cases of sore throat among persons not using Mr. V.'s milk were heard of in the course of the inquiry, but I am informed that sore throats have not been especially frequent in Macclesfield lately, except mumps, which has been rather prevalent.

* So far as I can learn these were really cases of mumps, and not true sore throat; but in order to avoid any suspicion of unfairness in the comparison, I have thought it best to include them in the table.

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especially incident upon large consumers of milk.

The case against the suspected milk is further strengthened when we come to consider the question of the quantity consumed by different persons. By the aid of the figures which I have obtained and given in the table in Appendix I., I am able to arrange the households in which Mr. V.'s milk was used in four classes, according to the average amount of milk per head used daily therein, with the result that the incidence of the disease both upon households and persons is shown distinctly to vary according to the quantity of milk used.

Average daily amount of Milk used per head.	Households.		Inmates.		Cases.			Pereentage attacked.	
	Total.	Attacked with Scarlet Fever or Sore Throat.	Under 15 years.	15 and above.	Scarlet Fever.	Diph-theria.	Sore Throat.	House-holds.	Persons.
1 pint and upwards -	9	8	10	30	8	—	12	89	50
$\frac{2}{3}$ pint and under 1 pint -	16	12	35	62	11	1	21	75	34
$\frac{1}{3}$ pint and under $\frac{2}{3}$ pint -	37	21	37	123	10	1	34	56	28
Under $\frac{1}{3}$ pint - -	38	17	68	127	9	—	16	45	12
Total -	100	58	150	342	38	2	83	58	25

The use in a household of a large proportion of milk usually indicates that milk is partaken of on several occasions during the day, and that it is used as a beverage, and not merely as an adjunct to tea or coffee, or in puddings. In the event of the milk becoming infected it implies that a larger total amount of poison is imbibed, that the occasions of exposure to its influence are more numerous, and that a larger proportion of what is taken has not undergone any process, as of cooking, which would destroy or impair its activity.

Many instances were met with in which those members of the household who were attacked, or were attacked first, were the chief drinkers of raw milk; and, on the other hand, in which the members who escaped were those who drank little or no milk, or drank it only boiled. Some of these instances are noted in the last column of the appended table. The proportion between the amount of milk taken, and the amount of sickness, though well marked when a series of cases is taken, was, however, in individual cases often interfered with by other circumstances, *e.g.*, the age of the inmates, the number of them protected by previous attacks, the sending away of other members of the household on the occurrence of the first case, the boiling of the milk wholly or in part, and its use in different modes and in unequal proportions by different members of the household.

The outbreak did not show any special incidence on children, if all the cases of whatever type be reckoned together; the percentages of persons attacked under and above 15 years being practically the same, 24·7 and 25·1. Taking, however, only the cases classed as scarlet fever, the percentage of persons using the suspected milk who were attacked was 16·7 of those under 15 years and only 3·8 of those above, or less than a fourth. In many epidemics ascribed to a milk origin a greater incidence on children has been noticed, owing to children being generally the largest milk drinkers. This however does not seem to be the case in the present one. From the table above it will be seen that in the households in which a pint or more of milk per head was used, of 40 inmates, only 10, or 25 per cent., were under 15, while in those in which less than one-third of a pint per head was used, out of 195 inmates 68, or 35 per cent., were under 15. I found that many adults were in the habit of drinking milk for supper, and of taking it cold with porridge for breakfast. In fact the proportion of milk used in a household depended more upon individual habit and on the possession of the means to buy it than upon the number of children in the household.

The severity of the illness has also appeared to depend upon the amount of milk which the patient was in the habit of consuming. The great majority of the severe cases, and two out of the three fatal ones, have occurred in households in which a large quantity of milk per head was taken, and in persons

who were great milk drinkers. On the other hand many of the cases which have occurred in households (chiefly those of the artizan class) in which a small relative amount of milk was taken have been of a mild or doubtful nature; they were not attended by a medical man, and were only heard of by making a house-to-house enquiry at all the houses where Mr. V.'s milk was taken.

Clinical features.

As already mentioned, the cases of illness, associated together in the present outbreak by the connexion of a common milk supply and a nearly simultaneous commencement, have presented differences in symptoms, which have led to some being classed as scarlet fever, others as diphtheria, and others again as diphtheritic sore throat or simply as sore throat. Some of the milder cases of sore throat, such as those lately referred to, may have been of a different nature, or due to ordinary causes, but so far as the information which I have been able to obtain of the clinical history of the cases has enabled me to judge, I am of opinion that all the severe and well marked cases, by whatever name called, have been essentially of the same nature and due to the same cause, the differences between them depending upon the age and constitution of the patient, and the amount of the poison taken. The seed has been the same in all cases; the crop has varied according to the amount of it sown, and the nature of the soil on which it fell. My reasons for this opinion are:—

1st. That the cases of scarlatinal type have occurred chiefly in children under 15 (25 out of 38), and the remainder mostly in young adults, or in persons who had not had scarlet fever before; while the cases of sore throat without rash have occurred chiefly in older persons, in whom rashes on the skin are less prone to develop and less readily seen; or in those in whom the complete development of scarlet fever was prevented by the patient having previously suffered from an attack of that disease.

2nd. That in a few cases of persons who had suffered from sore throat, but on whom no rash had been seen, the skin was afterwards found to be peeling.

3rd. That in many of the households in which children suffered from scarlet fever, older persons suffered at the same time from sore throat without rash.

4th. Both of the well marked cases of diphtheria were similarly accompanied by cases of sore throat of a less severe and not distinctly diphtheritic character.

5th. The severer cases of sore throat,—"diphtheritic sore throat"—are described as having presented scattered dots of whitish deposit on the tonsils around the mouths of the follicles: in the distinct cases of diphtheria, similar dots coalesced into a continuous false membrane.

6th. In some of the cases of scarlet fever similar dots of deposit, in one case coalescing into a continuous membrane, were observed. The concurrence of the symptoms of diphtheria with those of scarlet fever in the same patient, or in causally connected cases, has not unfrequently been observed in other outbreaks.

7th. In the severer cases of sore throat without rash the sudden coming on of the sore throat and feverishness, and the frequently present delirium are symptoms resembling scarlet fever.

Some cases resembled scarlet fever,

The cases of scarlatinal type have presented the following clinical features. The disease has commenced suddenly, very commonly with vomiting, even in adults, and in some cases with purging also; with sore throat, headache, pains in the limbs, and prostration. A feeling of chilliness sometimes occurred, but in a few cases only were there distinct rigors. There was rapid onset of fever, the temperature in one case reaching 105° F. on the first day. Sore throat was present from the first, the fauces were inflamed (described as having been of a dark red colour like port wine), the tonsils were enlarged, and there was also an enlargement, in bad cases considerable, of the cervical glands below the jaw. In some cases a distinct fibrinous exudation appeared on the tonsils, thus connecting the cases of scarlatinal with those of diphtheritic type. The tongue rarely presented the white fur and red enlarged papillæ ("strawberry tongue") characteristic of scarlet fever; it was more often covered with a thick moist creamy white or dirty brown coat, or in other cases was red and smooth. The rash, which was

the distinctive feature of the type, began about the second day; in one case within 24 hours of the first symptoms, in another not till the fifth day; it was a copious scarlet rash, described by some of the medical men as resembling the ordinary rash of scarlet fever; but two medical men under whose care many severe cases had come, Messrs. Somerville and Hughes, considered that it differed somewhat from the scarlatinal rash as commonly seen; they described it as presenting, besides a scarlet blush, purplish blotches (compared to the mottling on the skin of a healthy infant after a bath); it appeared sometimes first on the hands and feet; and it was followed only by very slight desquamation. The last statement I can verify from my own observation: through the courtesy of the medical men in attendance I had the opportunity of seeing, towards the end of the third week of their illness, more than a dozen cases of scarlatinal type, in which there had been a copious rash; in only one of these was there distinct peeling of the skin; and that only on the hands; in the other cases the desquamation was so slight as to be barely perceptible; nor had there been more at an earlier stage.

In several cases the disease was accompanied by rheumatism of the joints, especially the wrists. In several cases (especially in one family) there were symptoms of ear mischief, viz., prolonged ear-ache, partial deafness, and in one or two instances offensive purulent discharge from the ear. In one case there was profuse watery discharge from the nose. In no case were kidney symptoms observed, nor was albuminuria found on any occasion on which it was looked for. Delirium was generally present in severe cases. The fever lasted about six days, or in some cases longer; in several there was a distinct relapse with a recurrence of throat symptoms about the tenth day. It left very considerable prostration. Only two cases out of 38 were fatal; the cause of death being certified as "malignant scarlet fever."

The scarlatina appeared to have little tendency to spread in the households into which it had been introduced. In 19 households there were multiple cases (cases of sore-throat occurring in households in which there had been fever being included), but in only five of these did an interval of four days elapse between the commencement of the first and second cases, and in only three did cases occur later than February 7th, *i.e.*, more than a week after the stoppage of the suspected milk.

This failure to propagate itself by infection from case to case, may have been due in some households to the fact of all the children having been attacked at the beginning, so that there were no susceptible individuals left to contract the disease from them. In others it may have been due to the precautions taken to separate the sick from the healthy, the more so as the greater number of the households invaded were of the well-to-do class, in which such precautions are more feasible than among the poor. So far as it was not thus explicable, the absence of tendency to spread may be connected (if the popular theory be correct that the scales shed from the skin are the chief carriers of infection) with the very slight amount of desquamation generally exhibited. A similar indisposition to spread by contagion has, however, been observed in other scarlatina epidemics of milk origin in which there has been no lack of peeling of the skin.

It will be seen from the foregoing sketch that the features of the disease have on the whole been those of scarlet fever, but that the outbreak has presented certain peculiarities, viz.:—

The frequency of vomiting and purging at the commencement.
The state of the tongue.
The character of the rash.
The scanty desquamation.
The slight tendency to spread by infection.
The absence of, at any rate conspicuous, kidney symptoms.

It is right to state that Messrs. Somerville and Hughes, to whom I am indebted for much of my information as to the clinical history of the disease, doubt that it has been scarlet fever, and are inclined to look upon it as a form of blood poisoning due to sewage matter conveyed through the medium of milk.

others diphtheria. In the course of the outbreak there have occurred two well-marked cases of diphtheria; besides a number of cases classed as "diphtheritic sore

" throat," and one or two in which a diphtheritic exudation appeared on the tonsils in the course of scarlet fever. The cases classed as diphtheria have been marked by the presence on the tonsils of a distinct false membrane, continuous, whitish, and fibrinous, and by the absence of a red rash on the skin.

In one case, in an elderly but previously healthy man, the diagnosis was confirmed by Dr. Renaud, physician to the Monsall Fever Hospital, Manchester. Albuminuria was present in this case, which proved fatal suddenly on the 12th day. The other case was in a young man, who was said to have previously suffered from an attack of "diphtheria" in infancy, at a time when the other children in the house were ill of scarlet fever. He was not known to have had scarlet fever then or since, but was liable to sore throat. His illness began with sore throat and shivering; on the second day he had a high temperature, but no rash; both tonsils and soft palate were covered with a yellowish white membrane, which was coughed up on the fifth or sixth day "like a piece of leather." There was not much enlargement of the glands in the neck; and no albuminuria was found on the only occasion on which it was looked for. No peeling of the skin, or local paralytic symptoms followed.

Others merely sore throat.

The cases classed as "sore throat" comprised those in which neither scarlet rash nor distinct diphtheritic membrane was present. They occurred mostly in adults and many of them in households in which other members had scarlet fever or diphtheria. They varied in severity from a feeling as of a common "cold," with slight soreness of the throat passing away in a few hours, to a serious illness, accompanied by fever and delirium, and confining the patient to bed for two or three weeks. No case, however, was fatal.

The local appearances were redness of the fauces, enlargement of the tonsils, with in some cases superficial ulcerations, or scattered dots of exudation at the mouths of the follicles, not, however, coalescing into a continuous membrane. Up to the time to which my information reaches, no case had been followed by symptoms of local paralysis, such as frequently (though not in all outbreaks) occur after diphtheria.*

Dates of outbreak.

The dates of the commencement of illness in the households supplied with Mr. V.'s milk, were as follows :—

Date.	Households newly invaded.	Cases in Households newly invaded.			Cases in Households previously invaded.		Total new Cases.			Grand total of cases.
		Scarlet fever.	Diphtheria.	Sore throat.	Scarlet fever.	Sore throat.	Scarlet fever.	Diphtheria.	Sore throat.	
January 24? †	2	1	—	1	—	—	1	—	1	2
„ 25	3	3	—	—	—	—	3	—	—	3
„ 26	4	—	—	4	1	—	1	—	4	5
„ 27 (Sunday)	9	6	—	3	2	3	8	—	6	14
„ 28	9	2	—	9	3	2	5	—	11	16
„ 29	2	2	—	2	4	2	6	—	4	10
„ 30	8	2	1	6	6	5	8	1	11	20
„ 31 } Milk discontinued after	6	2	1	11	1	2	3	1	13	17
February 1 } morning of 31st.	1	—	—	1	1	2	1	—	3	4
„ 2	2	1	—	2	—	—	1	—	2	3
„ 3	—	—	—	—	—	2	—	—	2	2
„ 4 ‡	3	—	—	3	—	—	—	—	3	3
Dates not accurately known but within above period.	9	—	—	9	—	12	—	—	21	21
Later	—	—	—	—	1	2	1	—	2	3
Total §	58	19	2	51	19	32	38	2	83	123

* One case was subsequently followed by a partial loss of sensation in the legs. Two cases in which no rash had been observed were followed by peeling of the skin.

† Of the two cases recorded as commencing on January 24th, one began late at night (or perhaps early on the morning of the 25th). The date of commencement of the other was somewhat doubtful; it was not notified to the borough authorities as scarlet fever until February 4th.

‡ Of the three cases of sore throat recorded as commencing on February 4th, two were of doubtful nature; of the other the date was somewhat uncertain.

§ In several instances two or more cases of sickness among the members of a household commenced on or about the same day.

It will be seen that the outbreak may be said to have commenced on January 25th and ceased on February 2nd; the great bulk of the cases having occurred between January 27th and 31st. These dates are of importance in seeking for the cause of the outbreak. The speedy falling off of the number of new cases after the stoppage of the milk, shows that the incubation period of the disease could not have been a long one; and the cause must therefore have been some circumstance or combination of circumstances which came into operation only a day or two before January 25th. The fact that fresh cases continued to occur during a period of at least nine days points to the milk having received a continuous supply of infection, rather than to its having become casually infected on one or two occasions only.

Having shown that the outbreak of scarlet fever and associated sore throat was due to infection distributed in Mr. V.'s milk, and that the milk must have become infected first within a few days before January 25th, we have now to enquire how the milk could have become infected. We have therefore to consider the circumstances of Mr. V.'s establishment with reference to—

Circumstances of dairy.

1. The sanitary condition of the premises.
2. The health of the inmates.
3. The routine of the business.
4. The health of the cows.

Mr. V.'s establishment was first visited in relation to the outbreak, on January 31st by the medical officers of health for the Macclesfield Urban and Rural districts, and by two other medical men. I myself visited it on February 11th and on several subsequent occasions, and as I have already said, found Mr. V. always most willing to give any information which might throw light upon the subject of the enquiry.

Sanitary condition.

Mr. V.'s establishment is a farm house in Upton, standing by itself a little way back from the road. The surrounding surface and the interior of the house were, at the time of my visit scrupulously clean. The scullery sink pipe discharges in the open air. In the cellar in which the milk stands (when any is kept over) there is a "sump" in the floor to catch water when the floor is washed: this was formerly connected with the drain, but the connexion is said to have been severed, and no offensive smell or current of air from the sump was discovered by me. The cellar wall was damp in the corner nearest to the privy. The privy is built against the house wall, and is entered from the wash house; it is insufficiently ventilated, and at my visit was very offensive. The space under the seat is connected with a drain which receives also the liquid from adjoining pig-styes, and discharges into a tank about 35 yards distant, the contents of which are pumped out once a year (last in March 1888) and distributed over the. land. The water supply of the household has, until after the outbreak, been obtained from a pump in the yard. The well is about 7 yards from the privy and pig-styes; the water had always been considered good, but at one of my visits it was turbid, with an unpleasant taste: becoming more turbid with floating particles on prolonged pumping. On analysis it was pronounced to be contaminated with sewage and unfit for drinking purposes. (See Appendix II.) This water was used for rinsing the milk cans, but (with certain exceptions to be hereafter mentioned) it was not drunk by the cattle, who resorted to a spring in a field, not likely to receive sewage pollution.

Health of inmates.

Mr. V.'s household consists of himself and Mrs. V., their adult son, two lads, and a servant girl. All the work of the establishment is done by them without any outside help. On enquiry as to their health, I was informed that Mrs. V. had had a bad cold on January 26th and lay in bed on Sunday morning, January 27th, but was better next day; her throat was said by one of the medical men who saw her on January 31st, to have been then red, and there was some redness and enlargement of one tonsil at my visit on February 11th, but no peeling of the skin could be detected. She is said to be liable to sore throat, and even if her ailment had been of the same nature as the other cases, the date shows that it could only be looked upon as an incident in the outbreak and not as its cause. The other members of the household (who drank a good deal of milk) had all been perfectly well, and were free from sore throat or peeling of the skin. One of the lads had come from Pendleton near Manchester on December 31st, none of the others had been away from home further than Macclesfield.

In December and January scarlet fever was prevalent in the neighbouring village of Prestbury, two miles from Upton. It was evidently spread by personal communication between the children of different households at school and elsewhere. At the time of my visit the village school was closed on account of a case of scarlet fever in the schoolmaster's family. Two children in a family living at Back Lane, Upton, in a cottage about a quarter of a mile from Mr. V.'s farm, were taken ill of scarlet fever on January 24th and 30th respectively; both had attended Prestbury school up to the time of their illness, and the child first taken ill had sat next to one who had recently returned to school after an attack of scarlet fever. They had used no milk before the illness. No communication could be ascertained to have taken place between Mr. V.'s household, and this family, or any of those at Prestbury.

Nearest cases of scarlet fever.

Mr. V.'s business consists ordinarily solely in the purveying of milk. He sells daily 10 or 11 dozen quarts. His milk is obtained on six days in the week solely from his own cows (except that occasionally his son, who takes out the milk, purchases a little on his rounds from other milkmen to make up the required quantity, if his stock should run short). On Sunday morning a larger quantity of milk is required than on other mornings, and the additional quantity, 16 to 21 quarts, is obtained from another farmer in Upton, Mr. L. Mr. L. does not retail his milk, but uses it on week-days to make butter, which he sells to shopkeepers in Macclesfield. On Sunday evenings there is less demand for milk, and what is over of Mr. V.'s supply is allowed to stand for cream. Only three of Mr. V.'s customers had had cream from him during the week before the outbreak.

Routine of business.

The cows are milked between five and six a.m., and four and five p.m., by Mr. V., his son, and the servant girl, and the milk after straining is sent out at once; the whole quantity being mixed in one can. The cans are scalded morning and evening with boiling water, they are then rinsed out with cold water, and placed upside down on a stand in the yard to drain dry. The water used for scalding and rinsing the cans is obtained from the pump before mentioned. It is obvious that the contamination of this water—a matter that has doubtless been going on for years—will not by itself suffice to explain the recent sudden outbreak of disease among the milk drinkers.

The milk is taken out by Mr. V., junior, in a large can in a cart; the servant girl or a lad going with him in the first part of the round to help him distribute it. The milk is ladled out into the customers' vessels either direct from the large can, or, at houses standing back from the road, from a smaller can which is filled by ladling from the large one and taken to the customers' doors, and sometimes into the houses, and from this the required quantity is ladled out into the customers' vessels.

It was suggested by Dr. Rushton, medical officer of health for the rural district, and by Mr. V., junior, that the milk might have become infected in the course of delivery in the following way. It seems that it is the custom in delivering the milk to dip it out of the can with a measure and pour it into the customer's jug or basin, which is held over the open can. Any drops of milk which might be spilt would run down the outside of the customer's vessel, and drop off the bottom into the can. If the vessel used to receive the milk had come out of a sick room, or were not clean on the outside—and Mr. V., junior, assures me that he has known such things to take place—the milk in the can might become contaminated. Similarly in filling the small can from the large one, it is thought that the contents of the latter might be contaminated. It does not appear to me that this risk is a great one, but, such as it is, it can easily be avoided by obvious precautions in measuring out the milk. The following considerations moreover appear to be fatal to the hypothesis which attributes the outbreak to infection conveyed in the manner suggested.

First. The absence so far as is known—and the opportunities for obtaining information have, in this instance, been unusually complete—of any earlier cases of scarlet fever among Mr. V.'s customers from whom the infection might be derived. All the cases have occurred within a period of 10 days or so. Nor have the customers who came earliest

on the round been the earliest attacked. The earliest cases were in households Nos. 8, 13, 31, 75, and 78 on the list in Appendix I., the latest households attacked were Nos. 5, 42, 24, 55, and 70.

Second. Were the hypothesis true, the customers who come last on the milkman's rounds would be the most likely to suffer, since they would run the risk of receiving infection from all visited before them, whereas it will be seen from the table at the end that the houses in Upton which came first on the list suffered more than those which came in the later part of the round; the difference being explicable by the difference in the amounts of milk taken. At the first house on the list the milk was not delivered on the milkman's round, but separately direct from the farm; yet in this house a case of scarlet fever occurred, commencing January 27th.

One household, No. 34, had milk from one cow, besides milk from the general stock. The child who had the milk suffered from scarlet fever, but later than another patient in the house.

The three households, Nos. 2, 3, and 48, at which cream was taken, all suffered more or less severely.

Mr. L.'s milk does not appear to have been concerned in the outbreak; it was distributed only in the morning delivery on Sundays, *i.e.*, on January 20th and 27th, so that had it contained the infection one would have expected a number of cases to have commenced close together about the middle of the week, *i.e.*, after the lapse of a period of incubation of two, or three, or four days after it was distributed. A reference to the preceding table on page 7. will show that this was not so, but that 8 cases commenced on the Friday and Saturday, 14 on the Sunday (several of them beginning in the early hours of the morning), and 16 on the Monday. These would give intervals from the occasions of distribution of Mr. L.'s milk, either too long or too short for the incubation of scarlet fever.*

It occurred to me whether the milk might have become infected by the cloths used for straining it. For this purpose Mr. V. uses bath towels, the soft fluffy texture of which he finds to retain impurities better than the kind of cloth commonly used for the purpose. I am informed, however, that these cloths have been in constant use for straining milk for over two years; that they have never been used for any other purpose, and that they were new when they were bought. Immediately after use they are put into hot water and washed. Every two days the cloths, four in number, are boiled for four hours, rinsed, dried, mangled, and placed in a separate drawer ready for use.

Health of cows.

We have lastly to consider the health of the cows yielding the milk.†

Mr. V.'s herd consists of 14 milch cows, kept in two sheds communicating with each other, at the back of the yard behind his house. The ventilation of the sheds is regulated so as to keep up a temperature of not less than 55° F., there being no artificial means of warming. The sheds are kept clean, the dung and soiled litter being removed three times a day. The cows are fed on chopped hay, turnips, Indian corn, and grains. The grains come by rail from Burton-on-Trent; the other articles, except the Indian corn, are grown on the farm.

The cows were examined on January 31st by several medical men, who detected nothing wrong with them. They have since been examined by Mr. Beard, veterinary surgeon, of Macclesfield, and by Mr. Lewis, chief veterinary inspector for Cheshire, who pronounced them in good health (*see* Mr. Lewis's report, Appendix III.). They were also examined on February 11th in my presence by Major Landon, veterinary inspector to the Privy Council, whose opinion, I understood, was to the same effect.

On inquiring as to any circumstances in connexion with the herd, which might coincide in time (allowance being made for the period of incubation) with the commencement of the outbreak of scarlet fever, I was informed by Mr. V. that on January 14th he had purchased two new cows of a dealer of repute in Macclesfield, to whom at the same time he sold two cows, which

* Mr. L.'s establishment was visited. His household, consisting only of himself, wife, and daughter, were in good health, and exhibited no signs of having suffered from scarlet fever. No history of communication with scarlet fever cases could be elicited. His cattle, only two of which were in milk at the time, were in good health.

† Inquiries were made as to the occurrence of disease among pigs or other domestic animals on the premises, but none was heard of.

were beginning to run dry, and were getting fat. The latter cows went to a butcher at Manchester.

The two cows bought by Mr. V. were purchased by the dealer from farmers in the neighbourhood, one at Butley and one at Macclesfield Forest, and were brought to the dealer's sheds the day before they were delivered to Mr. V., being stalled there with a number of other cattle collected from the country round. I visited the farm and examined the cows at Butley, and I saw the farmer from Macclesfield Forest, but did not learn of any illness among the cattle at either place, nor of any scarlet fever among the people at either farm. At the farm at Butley the milk is sent to Manchester, at the other it is made into butter which is sold in Macclesfield. The farmer at Macclesfield Forest gives the date of purchase of his cow as January 15th, and if this be correct it would not come into Mr. V.'s possession till January 16th. The dealer had kept no record of the date. The discrepancy is not material to the issue.

Of the two cows bought by Mr. V. on or about January 14th, one had calved about four days before. Its calf was not with it. Its milk was at once added to the general stock. The other cow calved on January 20th. I am informed by Mr. V., junior, that the calving and cleansing were perfectly natural. The milk of a newly calved cow, called by dairymen "beastings," is not at once mixed with the general stock, as it is albuminous and sometimes tinged with blood; it coagulates with heat, and is sometimes used for making puddings and custards. After six milkings it is added to the other milk; but before doing so, Mr. V. takes the precaution to boil some to make sure that it is no longer coagulable by heat. In the case of the cow which calved on January 20th, the "beastings" were not bloody, and presented no peculiar appearance. Only one customer (No. 1 on the list) had any, the calf being allowed to suck.

The milk of the newly calved cow was first distributed with the general supply on the evening of January 23rd, a date which accords sufficiently well with the first outbreak of fever. There is therefore strong ground for suspicion that there was something in the state of this cow that gave the milk its infective quality. On examining the cow on February 11th, I found no scabs or sores on the udder or teats. The cow had a few bare patches, $1\frac{1}{2}$ to 2 inches in diameter, on the rump on either side, around which the skin was scurfy, and the hair could be pulled out. No vesicular eruption on the skin was found. The temperature (February 11th) was 101° F., the normal temperature of the cow being stated to range between 100° and 102° F. On one occasion a yellowish slimy vaginal discharge was noticed. The calf was healthy and thriving; it had not after the first three days been fed specially on its mother's milk. The other cow bought on or about January 14th had many bare patches on the neck, and a few on the back and rump, on one of which was a thin scab (attributed to scratching). Its temperature on February 11th was 101·4° F. Several of the other cows, especially of those in the same shed with the above, had similar bare patches on the neck, rump, and root of tail; none had any sores or scabs on the udder or teats.

Mr. V. states that he has never had his cattle in better health than they have been all through the present winter, and that they have been remarkably free from chapped teats.

The cows have been kept in the sheds since December, but are let out every day to drink water at a spring in a neighbouring field. The two cows, however, which were bought on January 14th were not let out to drink, but were given water from the contaminated pump well before mentioned.

(Since January 31st, water from the Macclesfield Corporation Waterworks has been laid on to a tap at Mr. V.'s farm.)

Mr. V. stated that he had not noticed any ropiness or unusual appearance about the milk lately. Nor did I hear from any of his customers any complaint of suspicious appearance, taste, or smell; in fact, the milk seems to have borne an excellent reputation. A sample taken on January 31st was pronounced by the public analyst to be genuine and of good quality; but it must be remembered that the germs of infectious diseases cannot be detected by chemical analysis.

To sum up, while the connexion of the outbreak with the supply of milk from Mr. V.'s farm seems to be beyond doubt, the way in which the milk became infected remains obscure.

The dates of attack of the several cases show that the source of infection, whatever it may have been, came into operation about January 23rd, and continued in operation until the stoppage of the milk on January 31st. No continuous source of infection of human origin can be discovered by careful investigation; the possibility cannot perhaps be absolutely denied that the milk may, on some occasion, have casually received infection from a human source, but there is no evidence that it has done so; moreover, a single such occurrence would not explain the succession of cases, nor, unless it took place at the farm itself, would it account for the distribution of cases among the customers.

The only circumstance that I have been able to discover fulfilling, in point of time, the requirements of the case, is the addition, on January 23rd, to the general stock of milk of that yielded by the cow which calved on January 20th, and the only explanation which suggests itself as to how the milk of this particular cow could have come to have infectious properties is that the cow herself may have developed in the puerperal condition, some ailment so trivial or so evanescent as to have escaped the notice, not only of her owner, but also of the eminent veterinary authorities who at a later stage (first on February 5th) examined her. Such ailment may have originated either from infection brought with her by the cow, or from the sewage-polluted well water which she drank. (The other cow which drank the same water had already calved some four days when she came, and by that time the puerperal condition, with its especial susceptibility to disease, would be passing off.)

It may be remarked that in several instances in which outbreaks of scarlet fever or diphtheria have followed the distribution of milk from a particular dairy, without any extraneous source of infection being discoverable, the dairy in question has been what has been looked upon as a model one; in which careful precautions had been taken to exclude risk of infection from human sources, and the cows were well fed and well attended to. In such dairies the cows are kept tied up in sheds at an equable temperature, so that as little as possible of the nutritive material taken in the food may be expended in muscular exercise and in keeping up the bodily heat, and as much as possible recovered in the form of milk. A cow living under these conditions may be looked upon as a milk-producing machine worked at high pressure, and hence perhaps specially susceptible to infection.

Sanitary condition.

As regards conditions other than milk supply, many of the patients were members of the families, or domestic servants, of well-to-do people, living in good roomy houses, with usually fairly well planned drainage and other sanitary arrangements. Others were of the lower middle, and working class, but at few of the houses of Mr. V.'s customers were there any obvious sanitary defects. The water supply was in all cases from the Corporation waterworks, the same as the rest of the borough. Although the persons attacked lived on the west side of the borough, they did not all live in close proximity to each other, but were interspersed among a great many others who were supplied with milk from different sources, and did not have scarlet fever. It was not therefore merely a case of scarlet fever attacking a particular locality in which the majority of houses chanced to be supplied with milk by a particular dealer.

Personal communication.

As regards personal intercourse, the patients were of different ages, sexes, and social conditions; and no occasion was discovered, or was likely to have occurred, at which they could have contracted infection, without other people, who obtained milk from different sources, being involved in an equal risk.

As regards school attendance, the following table shows in how many households the person first attacked attended school, and which schools such persons attended.

Households in which first patient was—

Child under school-going age - - - -	1
Person above school-going age - - -	40
Child of school-going age but not attending school -	4
Governess at a private school - - - -	1
Attending Grammar school (one a master) - -	3
„ High School - - - - -	3
„ Modern School - - - -	1
„ Christ Church School - - - -	1
„ National School, Duke Street - -	1
„ Roman Catholic School - - - -	1
Child; at which school, if any, not recorded (one a little girl, one a boy of working class) - - -	2
	58

There was in certain quarters a disposition to attribute the outbreak to infection spread from the Grammar School, at which there had been an outbreak of scarlet fever in the autumn of 1888. The master's house and the school had been carefully disinfected since the attack. The boarders came back after the Christmas holidays on January 20th, and on January 21st the whole school, including masters and day boys, reassembled. Three of the head master's children and a boarder were taken with scarlet fever, January 27th–31st, 1889, and another master, not living in the same house, on February 2nd. All these persons were large drinkers of the suspected milk. Careful precautions were taken to prevent danger to the other boys, and, as a matter of fact, at only one other household was the first patient a boy attending the Grammar School, and he, having met with an accident, had not been at school for some days before the symptoms of fever appeared. Three other day boys attending the same school suffered, but only after there had been other cases in their households, which were supplied with milk from Mr. V.'s dairy. I see therefore no reason to think that the Grammar School had any share in producing the outbreak. On the occurrence of scarlet fever in his family, the head master of the Grammar School removed the patients to an empty house in another street. For this he was much blamed, but the act of removal was not in itself illegal if conducted, as appears to have been the case, with due precautions against spreading the disease; there has been no spread of the disease in the neighbourhood to which the patients were removed, and it is difficult to see what better course could have been taken in the absence of accommodation for isolating the patients at a hospital, which was not then available.

Hospital provision.

The Macclesfield Corporation have a Ducker temporary hospital erected in an open situation outside the town (though within the borough limits). It was erected two years ago on the occasion of an outbreak of small-pox, and has hitherto been reserved for cases of that disease. It contains two wards in one block, each containing six beds with about 1,050 cubic feet of air space apiece. It was not in a state to receive patients at the time when the outbreak of scarlet fever occurred, even if the authority had been willing to allow it to be used for that disease. It has, however, been since made ready for scarlet fever cases from the borough, and at the time of my visit on February 20th one such patient was in it.

At the time of my visit to the district I found that all action immediately necessary had been or was being taken to prevent the spread of the disease. The supply of the suspected milk had been discontinued, Mr. V. using it to make cheese, and agreeing to wait until the meeting of the Rural Sanitary Authority on March 5th before resuming its distribution. The tap water had been laid on to his dairy. At the time of the outbreak the Rural Sanitary Authority were without an inspector of nuisances, the late officer having recently died and a new one not having been appointed. The reconstruction of the privy was left for the new inspector to deal with. At the village of Prestbury a good many matters requiring the intervention of this officer were observed.

I have to thank Dr. Rushton and Mr. Bower, medical officers of health respectively for the Macclesfield rural and urban districts, and other officials, and several of the other medical men practising in Macclesfield, for valuable assistance willingly rendered during the investigation.

March 2nd, 1889. H. FRANKLIN PARSONS.

POSTSCRIPT.

Learning that the resumption of distribution of Mr. V.'s milk had been followed by some cases of scarlet fever and sore throat similar to those in the first outbreak, I visited Macclesfield again on March 23rd.

Although Mr. V. had ceased to take round milk, a few people had fetched it from his farm since my first visit. Among these there had been another case of scarlet fever at household No. 1 in the list, at which there had been a previous case.

On March 6th, with the sanction of the Rural Sanitary Authority, Mr. V. resumed delivering milk, about 60 households taking it. At a good many of these the precaution of boiling it is said to have been observed. About March 11th one case of scarlet fever, and three of diphtheritic sore throat similar to those in the first attack, occurred, but all of them in households previously invaded, or under such circumstances that their connexion with the milk supply could not be positively affirmed. The following are the particulars of these cases :—

1. Miss M., at household No. 19 in list, was taken ill of scarlet fever on March 11th. After her brother's death, on February 1st, the family had gone to the seaside, and the house, during their absence, had been thoroughly fumigated and cleansed. On February 2nd Mr. M. himself was poorly for three days, and had enlarged glands in the neck, but no rash or sore throat; and while away from home his skin peeled profusely. His daughters, aged 13 and 3½, were much with him all the time. The family returned home on March 7th, and took Mr. V.'s milk from March 8th; the elder girl drank a good deal, the other only a little in tea and with porridge. On March 11th the elder girl was taken ill with an attack of scarlet fever, with a rash and slight desquamation; the other one had escaped up to the time of my visit, although equally exposed to infection from any other source but the milk.

2. Mr. S., at household No. 29, one not previously invaded, was a great friend of the last family; he met them on their return on March 7th, and was much with them up to March 10th. He had had V.'s milk from March 7th, but only took it in tea. On March 11th he was taken ill with "diphtheritic sore throat," without rash or subsequent peeling.

3. Mr. W., household No. 94, had suffered from sore throat in the previous outbreak, but in the meantime had recovered and "had never felt better in his life." He had had V.'s milk in tea and coffee since March 6th, and on March 9th he drank half a pint unboiled. On the evening of March 10th he had a slight sore throat, and on March 11th felt very ill, with shivering at night and difficulty in swallowing. On March 12th he was seen by a medical man, and had then a temperature nearly 104° F., and an inflamed sore throat of a dark port wine colour. Next day there was a greyish patch on one tonsil, and on the 21st there was slight albuminuria, which was noticed twice, and then disappeared. His son, who drank some of the milk unboiled on the evening of March 12th, had ear-ache and sore throat a day or two after.

4. At household No. 92, a servant had had sore throat in the previous outbreak, and had left. On March 6th another servant came from Staffordshire; she had been poorly for some time before with an "ulcerated throat," and vomited on her journey to Macclesfield. Next day, however, she was better, and continued so until March 12th, when she again vomited, and next day had a sore throat. She had a severe illness, with a temperature reaching 103° F., and diphtheritic patches on the tonsils. She had taken V.'s milk since her coming, but only in tea. The two children, who were much with her, and also drank much milk, escaped; they had had scarlet fever in the previous year.

The history of the following household may be contrasted with the above :—

At household No. 34, Mrs. H. was taken ill on January 30th with sore throat and feverishness. She had been that day to see a relative (No. 75), whose servant was then ill with scarlet fever, having been one of the first cases (January 24th ?). Mrs. H. had no deposit on the throat, and no rash. On February 1st, her baby, a year old, was taken ill with feverishness, sore throat, and swollen glands; it had a slight red rash, which soon disappeared, and was not followed by peeling. The servant and another child were sent

away to another part of the town, where scarlet fever is not known to have existed; they returned home on March 1st, the house having been disinfected. In this household V.'s milk was used up to January 31st, but had not been taken again. On March 9th the servant who had been away was taken ill with sore throat; next day she had a scarlatinal rash, and was removed to the hospital; her skin afterwards peeled. On March 11th the boy had rash and enlarged glands, but not sore throat, and there has been no peeling. On March 12th the baby, who had been ill before on February 1st, was taken ill again with vomiting: a copious rash came out which lasted a week, and was followed by profuse peeling of the skin.

On the occurrence of fresh cases of illness among his customers coming to his knowledge, Mr. V., on March 13th, left off adding the milk of the cow which calved on January 20th to the general stock, and it has since then been given to the calf. In the early part of March some pimples or vesicles developed on one of the teats of this cow; and at the time that her milk was rejected scabs had formed on these. On my visit on March 25th there was a thin adherent scab, about the size of a sixpence, dark in the centre and light at the edge, near the lower part of one teat. The teat felt sticky when grasped, and the milk came less readily from it than from the others, having had to be drawn off that morning with a quill. The cow had lost flesh. The calf was healthy.

H. F. P.

March 28, 1889.

APPENDIX I.

List of customers of Mr. V.'s dairy, showing number of inmates in each household, the delivery (morning M., night N.) at which served, the amount of milk taken, and the cases of sickness occurring among them.

A. In Upton.

Household.	Inmates.		Milk taken.			Cases of Illness.			Remarks.
	Children under 15.	Persons 15 years and upwards.	Delivery.	Usual daily quantity (pints).	Average daily amount per head (pints).	Scarlet Fever.	Diphtheria.	Sore Throat.	
1	3	3	M. N.	2	·33	1	—	1	Milk delivered separately from farm. First case began Jan. 27.
	—	6	M. N.	4 and cream.	·67	—	1	4	Fatal diphtheria. Patient largest milk drinker.
3	—	5	M. N.	3 and cream.	·60	—	—	3	Of two chief milk drinkers one had severe and one slight attack of sore-throat.
4	—	5	M. N.	3	·60	—	—	2	
5	5	2	N.	1	·14	—	—	1	
6	—	3	N.	3	1·00	—	—	—	All elderly.
7	2	3	N.	2	·40	1	—	1	
8	3	5	M. N.	8	1·00	1	—	5	Of the two who escaped one took no milk, the other only boiled.
9	—	4	M.	2	·50	—	—	2	Three milk drinkers, two attacked.
10	—	3	M.	2	·67	—	—	—	Milk not drunk. Chiefly used in puddings, &c.
11	3	3	M. N.	4	·67	1	—	1	Scarlatina patient had drunk much raw milk, also another child who escaped.
12	—	5	M. N.	4	·80	—	—	3	"Diphtheritic sore-throat." The three patients were chief milk drinkers.
13	3	5	M.	4	·50	3	—	1	Scarlet fever cases began Jan. 25, 26, and 27. Children large milk drinkers.
14	—	3	M. N.	3	1·00	—	—	2	"Diphtheritic sore-throat."
15	—	4	M. N.	2	·50	—	—	1	
16	—	3	M. N.	3	1·00	—	—	2	One case began two days after leaving home.
17	—	4	M. N.	3	·75	—	—	1	
18	—	6	M. N.	4	·67	—	—	—	Milk all boiled.
19	2	6	M. N.	8	1·00	1	—	—	Fatal case; large milk drinker.
20	—	1	N.	⅓	·33	—	—	—	
21	—	2	N.	⅔	·33	—	—	—	
22	2	2	N.	2	·50	—	—	1	Patient drank less milk than others, but liable to sore-throat.
—	23	83	16 19	—	—	8	1	31	

B. In Macclesfield Borough.

Households.	Inmates.		Milk taken.			Cases of Illness.			Remarks.
	Children under 15.	Persons 15 years and upwards.	Delivery.	Usual daily Quantity (pints).	Average daily Amount per head (pints).	Scarlet Fever.	Diphtheria.	Sore Throat.	
23	—	3	M.	2	·67	—	—	—	
24	—	5	M. N.	3	·60	—	—	1?	"Mumps."
25	1	4	M.	2	·40	—	—	—	
26	1	5	M. N.	3	·50	—	—	—	
27	3	3	M. N.	4	·67	2	—	1	
28	2	3	M. N.	3	·60	1	—	3	Scarlet fever patient had previous attack a year before.
29	—	4	M.	1	·25	—	—	—	
30	—	4	N.	2	·50	—	1	1	Diphtheria patient drank most milk, had "diphtheria" in infancy when others had scarlet fever, liable to sore throat.
31	3	2	M. N.	7	1·40	2	—	1	The child who escaped had boiled milk only, and had two meals daily away from home.
32	18	6	M. N.	18	·75	5	—	—	Scarlatina cases at once removed : six of those under 15 who escaped had had scarlatina previously.
33	—	8	M.	2	·25	1	—	2	
34	2	4	M. N.	6	1·00	2	—	—	
35	—	3	M.	1	·33	—	—	—	
36	—	3	M.	$\frac{2}{3}$	·22	—	—	—	
37	2	2	M. N.	3	·75	1	—	—	Other child protected by previous attack of scarlet fever.
38	—	5	M. N.	2	·40	1	—	—	Three protected by previous attacks.
39	2	2	M.	1	·25	3	—	—	Fatal case of scarlet fever.
40	6	4	M. N.	8	·80	1	—	5	Three children protected by previous scarlatina.
41	4	3	M.	1	·14	—	—	1	
42	1	2	N.	2	·67	—	—	1	
43	1	3	N.	$\frac{1}{3}$	·08	—	—	—	
44	4	2	N.	1	·17	—	—	—	
45	4	5	M. N.	1	·11	1	—	2	The four children escaped and were sent away at once, two of them were protected by previous attacks, and the other two drank little milk.
46	—	2	M.	1	·50	—	—	1	
47	—	2	M.	1	·50	—	—	—	
48	—	5	M. N.	4 and cream.	·80	—	—	4	
49	—	2	M.	1	·50	—	—	—	
50	—	2	M.	1	·50	—	—	—	
51	—	3	N.	$2\frac{1}{3}$	·78	—	—	—	
52	—	4	N.	1	·25	—	—	—	
53	2	2	N.	$\frac{2}{3}$	·17	—	—	1	The children escaped; they drank chiefly milk obtained in the morning from another source.
54	3	4	N.	1	·14	—	—	—	Milk all boiled.
55	—	5	M. N.	3	·60	—	—	2	Those who escaped had milk boiled.
56	4	1	M. N.	$1\frac{1}{3}$	·27	—	—	1	
57	—	2	N.	1	·50	—	—	—	
58	1	3	M.	$\frac{2}{3}$	·17	—	—	—	
59	3	2	M.	$\frac{2}{3}$	·13	—	—	1	
60	—	2	M.	$\frac{2}{3}$	·33	—	—	—	
61	—	2	M.	1	·50	—	—	—	
62	—	4	M.	1	·25	—	—	1	
63	—	3	N.	$\frac{2}{3}$	·22	—	—	1	
64	—	3	N.	1	·33	—	—	2	The one who escaped never took milk.
65	1	2	N.	$\frac{2}{3}$	·22	1	—	—	
66	1	3	M.	$\frac{2}{3}$	·17	—	—	—	
67	—	2	M.	$\frac{1}{3}$	·17	—	—	—	
68	3	4	M.	1	·14	—	—	—	
69	not ascertained.		M.	1	—	—	—	—	
70	2	3	M. N.	4	·80	1	—	—	Patient chief drinker of raw milk.
71	5	2	N.	1	·14	—	—	—	
72	4	4	M. N.	4	·50	—	—	6	Two adults escaped; one drank little milk, the other was much away from home.
73	6	2	M. N.	4	·50	—	—	—	
74	1	6	M. N.	2	·28	—	—	—	
75	—	2	M. N.	2	1·00	2	—	—	Much milk drunk raw by both.
76	3	4	M.	2	·28	2	—	1	The scarlet fever patients were the only ones in the house who liked cold milk.
77	5	2	M.	1	·14	—	—	—	
78	4	3	M. N.	3	·43	2	—	1	Chief milk drinker drank it only boiled, and escaped.
79	—	2	M.	$\frac{2}{3}$	·33	—	—	2 (?)	
80	—	4	M.	$1\frac{1}{3}$	·33	—	—	1	Patient drank most milk of anyone in the house.
81	—	2	M.	$\frac{1}{3}$	·17	—	—	1	
82	—	2	M. N.	4	2·00	—	—	2	Both large milk drinkers.
83	1	4	N.	1	·20	—	—	—	
84	—	4	M. N.	3	·75	—	—	1	

Households.	Inmates.		Milk taken.			Cases of Illness.			Remarks.
	Children under 15.	Persons 15 years and upwards.	Delivery.	Usual daily Quantity (Pints).	Average daily Amount per Head (Pints).	Scarlet Fever.	Diphtheria.	Sore Throat.	
85	—	10	M. N.	6	·60	1	—	1	
86	—	4	M.	⅔	·17	—	—	—	
87	—	5	M.	⅔	·13	—	—	1	
88	—	1	M.	1	·33	—	—	—	
89	1	3	M.	⅓	·17	—	—	—	
90	1	3	M.	1	·25	—	—	1	
91	1	1	M.	¼	·12	—	—	—	
92	2	3	M. N.	3	·60	—	—	1	Children protected by previous attacks of scarlet fever.
93	7	4	M. N.	4	·36	—	—	—	
94	3	3	N.	1	·17	—	—	1	Patient only one who drank milk unboiled.
95	—	3	N.	1	·33	—	—	—	Milk all boiled.
96	4	6	M. N.	2	·20	—	—	—	
97	—	—	M. N.	2	—	—	—	—	Removed.
98	—	5	M.	1	·20	—	—	—	
99	3	3	M.	⅔	·11	—	—	—	
100	2	2	M.	1	·25	1	—	—	
101	—	2	M.	1	·50	—	—	—	
102	—	6	M.	1	·17	—	—	—	
103	—	—	M.	⅔	—	—	—	—	Removed.

N.B.—The households up to about No. 69 are arranged as nearly as possible in the order in which they were visited; but after that point the morning and evening order differed, the latter part of the round being taken in the reverse direction in the evening to what it was in the morning. The latter part of the list follows most nearly the evening order. Besides the above regular customers, a few odd penny worths were occasionally sold on the road.

APPENDIX II.

A.

Stockport, 4th February 1889.

DEAR SIR,

I HAVE analysed the water brought by you on February 2nd, and find it to be a very bad water, as the following results indicate:—

Chlorine per gallon - -	17·5 grains.
Free ammonia - - -	0·96 parts per million.
Albuminoid ammonia - -	0·90 „ „

These results point unmistakably to sewage contamination, and show that the water is totally unfit for drinking purposes.

Yours sincerely,
(Signed) GEO. DAVIES, F.C.S.

Dr. Somerville.

B.

Bankfield, The Cliffe,
Higher Broughton,
Manchester
March 2nd, 1889.

DEAR SIR,

I ENCLOSE the Analyses of two waters, Nos. 1 and 2.

—	1. (Water from Spring at Mr. V.'s Farm.)	2. (Water from Pump at ditto.)
Appearance in tube - - - - -	Very clear.	Cloudy.
Total solids at 212° F. - - -	14	61
„ „ after ignition - - - -	11	49
Chlorine - - - - -	0·9	6·4
Oxygen required for 15 minutes - - -	·008	·025
Do. do. do. 3 hours - - -	·022	·028
Free Ammonia in one million - - -	·01	·16
Albuminoid do. do. - - -	·12	·12

No. 1 I consider to be a good water, but No. 2 I cannot call a sample of first-class water, but should look upon it as a water of doubtful purity. This water is contaminated with

vegetable matter, and this water is not one I should recommend for the supply of a large town. This water can be used for domestic purposes if no better can be procured.

I remain,

Yours truly,

J. L. Rushton, Esq., M.D. (Signed) J. Carter Bell.

N.B.—Mr. Bell has omitted to state on what scale his results, other than the amounts of free and albuminoid ammonia, are expressed, but grains per gallon are probably meant. Thus interpreted his figures in the case of No. 2 are much lower than those given by Mr. Davis for another sample of water from the same source: if on any other customary scale, as parts per 100,000, or per million, the difference would be greater still. But even on Mr. Bell's figures for No. 2, I should be inclined to go farther than he does, and say that his results pointed unmistakably to sewage contamination, especially when compared with No. 1, from a spring issuing within a few hundred yards of the well from which No. 2 was drawn, and probably from the same strata.

H. F. P.

APPENDIX III.

1, South Street, Nantwich Road,
Crewe,
February 16, 1889.

Sir,

I have the honour to report that on receipt of communications from your Clerk and Medical Officer of Health, I attended at Macclesfield on the 7th instant, for the purpose of rendering my assistance as a veterinary surgeon in the investigations relating to the outbreak of scarlatina and diphtheria prevailing in Macclesfield and its neighbourhood. And having received information that in a certain district the fever attacks had occurred almost without exception among persons who had consumed milk supplied from Mr. W. V.'s dairy at Upton, I proceeded, in company with Dr. Rushton, Dr. Bower, and Mr. Beard, V.S., to Mr. V.'s farm, and being informed by him that a portion of his milk supply had been obtained from the dairies of Mr. J. L., Yew Tree Farm, Upton, and Mr. S. W., Fallibroome Farm, I visited their premises and milking cattle also.

Mr. V.'s farm comprises 35 acres, and in his shippons I found 14 cows, all of which were apparently in good health and condition; their skins and udders were free from suspicious eruptions; the temperature of each cow (ascertained with the thermometer) did not exceed the normal height; their food was of good quality; their drinking water (samples of which were said to be undergoing examination by the county analyst) had no suspicious appearances; the house and premises were in a condition of cleanliness creditable to the occupier; and the general sanitary surroundings as presented to my notice were satisfactory.

Mr. L.'s farm contains 27 acres, and on his premises I found six cows, one of which had aborted six weeks previously. I took the temperature of each animal, and I found it normal. No symptoms of febrile disease nor suspicious looking eruptions on the skin and udder were discoverable.

Mr. L. stated that he had supplied Mr. V. with milk for four or five weeks on Sundays *only*, and that the last lot supplied was delivered on January 27th last, 11 days before my visit.

Mr. W.'s farm has an extent of 107 acres, and his shippons contained 22 cows besides young stock, none of which presented symptoms of any infectious disease. The last lot of milk supplied from this farm to Mr. V. was delivered, it is stated, on November 30th last, that is upwards of eight weeks before the reported occurrence of the first case of scarlatina in the present outbreak. Mr. W. informed me that he had also been supplying about 12 quarts of milk daily to Mr. Fisher, 12 quarts daily to Mr. Whittaker, and three quarts daily to Mr. Shaw, and it was alleged that no persons who had partaken of this milk were attacked with fever.

In my opinion, the cattle I examined on the farms I have named, and the milk *as drawn from the udder*, were free from all disease capable of causing scarlatina and diphtheria in the human subject, and unless the milk became contaminated after its withdrawal from the udder, it could not possibly disseminate either of those forms of disease. There does exist, no doubt, the possibility that in various modes and at different places during the period elapsing between its abstraction by the milker and its consumption by the public, the milk may have become contaminated by contact with the infective germs of fever; but at present, the evidence in my possession with regard to its possible sources of infection, and the results of its consumption in the persons who partook of it, is not sufficient to enable me to express an opinion as to whether it *did* become infected or not. It is, however, very certain that contagious diseases may be disseminated by the agency of infected milk. (And here I beg to remark parenthetically, that suspected milk if used for human consumption should be boiled, in order to destroy any infective germs that may be present in it.)

During an experience of over 30 years among the dairy stocks of Cheshire and adjoining counties, I have never seen or heard of cattle being attacked with infectious scarlatina, or with any other disease capable of communicating scarlatina to man.

* * * *

I have the honour to be, Sir,
Your obedient servant,
WALTER LEWIS, M.R.C.V.S.,
Chief Veterinary Inspector of Cheshire, Provincial Veterinary Surgeon to the Royal Agricultural Society of England, &c.

To the Chairman of the
Macclesfield Rural Sanitary Authority.